

Claims:

1. A power generator for an underwater vessel that transits through an underwater thermocline having a temperature range, said power generator comprising:

at least a portion of a shell of an underwater vessel made from a thermally conductive material, said portion having an outer surface in contact with a surrounding underwater environment and an inner surface opposing said outer surface and not in contact with said surrounding underwater environment;

a plurality of thermo-to-electric energy converters electrically coupled together, each of said plurality of thermo-to-electric energy converters having a first surface and a second surface with said first surface being thermally coupled to said inner surface of said portion of said shell; and

a phase change material thermally coupled to each said second surface of said plurality of thermo-to-electric energy converters, said phase change material having a phase change temperature that is approximately equal to an average of upper and lower temperature extremes of said temperature range of said underwater thermocline, wherein said plurality of thermo-to-electric energy converters generate electrical power as the underwater vessel transits through said

24 underwater thermocline.

1 2. A power generator as in claim 1 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth
4 telluride-antimony telluride.

1 3. A power generator as in claim 1 wherein said phase change
2 material is a paraffin wax.

1 4. A power generator as in claim 3 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth
4 telluride-antimony telluride.

1 5. A power generator as in claim 1 further comprising a
2 material structure having tubular passages formed therein and
3 filled with said phase change material, said material
4 structure positioned adjacent said plurality of thermo-to-
5 electric energy converters.

1 6. A power generator as in claim 5 wherein said phase change
2 material is a paraffin wax.

1 7. A power generator as in claim 6 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth
4 telluride-antimony telluride.

1 8. A power generator as in claim 1 wherein said plurality of
2 thermo-to-electric energy converters are electrically coupled
3 together in series.

1 9. A power generator as in claim 1 wherein said plurality of
2 thermo-to-electric energy converters are electrically coupled
3 together in parallel.

1 10. A power generator for an underwater vessel that
2 repeatedly transits through an underwater thermocline having
3 a temperature range, said power generator comprising:

4 at least a portion of a shell of an underwater vessel
5 made from a thermally conductive material, said portion
6 having an outer surface in contact with a surrounding
7 underwater environment and an inner surface opposing said
8 outer surface and not in contact with said surrounding
9 underwater environment;

10 a plurality of thermo-to-electric energy converters
11 electrically coupled together, each of said plurality of
12 thermo-to-electric energy converters having a first surface
13 and a second surface with said first surface being thermally
14 coupled to said inner surface of said portion of said shell;
15 and

16 a thermal buffer thermally coupled to each said second
17 surface of said plurality of thermo-to-electric energy
18 converters for maintaining each said second surface at a
19 temperature that is approximately constant as the underwater
20 vessel repeatedly transits through said underwater
21 thermocline, wherein said plurality of thermo-to-electric
22 energy converters generate electrical power.

1 11. A power generator as in claim 10 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth
4 telluride-antimony telluride.

1 12. A power generator as in claim 10 wherein said phase
2 change material is a paraffin wax.

1 13. A power generator as in claim 10 wherein said plurality
2 of thermo-to-electric energy converters are electrically
3 coupled together in series.

1 14. A power generator as in claim 10 wherein said plurality
2 of thermo-to-electric energy converters are electrically
3 coupled together in parallel.

1 15. A method of power generation comprising the steps of:

2 providing an underwater vessel having at least a
3 portion of a shell thereof made from a thermally conductive
4 material, said portion having an outer surface in contact
5 with a surrounding underwater environment and an inner
6 surface opposing said outer surface and not in contact with
7 said surrounding underwater environment;

8 providing a plurality of thermo-to-electric energy
9 converters electrically coupled together, each of said
10 plurality of thermo-to-electric energy converters having a
11 first surface and a second surface;

12 positioning said plurality of thermo-to-electric energy
13 converters such that each said first surface is thermally
14 coupled to said inner surface of said portion of said shell;

15 thermally coupling a phase change material to each said
16 second surface of said plurality of thermo-to-electric energy
17 converters, said phase change material having a phase change
18 temperature that is approximately equal to an average of
19 upper and lower temperature extremes of said temperature
20 range of said underwater thermocline; and

21 transiting the underwater vessel through said
22 underwater thermocline, wherein said plurality of thermo-to-
23 electric energy converters generate electrical power.

1 16. A method according to claim 15 further comprising the
2 step of continuously repeating said step of transiting.

1 17. A method according to claim 15 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth
4 telluride-antimony telluride.

1 18. A power generator as in claim 15 wherein said phase
2 change material is a paraffin wax.

1 19. A method according to claim 15 further comprising the
2 steps of:
3 providing a material structure having tubular passages
4 formed therein and filled with said phase change material;
5 and positioning said material structure adjacent said
6 plurality of thermo-to-electric energy converters.

1 20. A method according to claim 19 wherein said phase change
2 material is a paraffin wax.

1 21. A method according to claim 20 wherein each of said
2 plurality of thermo-to-electric energy converters is selected
3 from the group consisting of bismuth telluride and bismuth

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4 telluride-antimony telluride.